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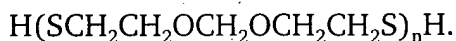
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### REMARKS

Before addressing the Final Action, the Applicant's wish to explain the amendment made to the specification. In particular, the formula provided for the Thiokol brand of dimercaptans at page 10 was inadvertently provided as



instead of



Support for the correct structure of the Thiokol dimercaptans is evident from U.S. Patent No. 3,781,250 as well as a 1997 brochure from Morton Polymer Systems, the current supplier of Thiokol® LP polymers. A copy of the brochure is appended as Exhibit A. U.S. Patent No. 3,781,250 was recently submitted in the subject application in the Applicants Third Supplemental Information Disclosure Statement, dated December 9, 2003. With reference to column 2, line 71, the formula for Thiokol is presented. At column 2, lines 5-6, the patent identifies a specific dithiol, Thiokol LP 3, which is also disclosed and utilized by the Applicants. Corresponding amendments have been made to dependent claims 3, 8, 12, and 17.

The Examiner has rejected claims 1-20 under 35 U.S.C. §112, second paragraph, as being indefinite, alleging that "it is unclear what the structure of the difunctional cross-linking agent embraces when  $m = 0$  given that sulfur is divalent and would be linked only to a single group R in cases where no Y group is present." In reply to the explanation provided by the Applicants in their first response, the Examiner states:

"With regard to the issue of the structure of the difunctional cross-linking agent when  $m = 0$ , applicants argue that in such an instance 'the agent is embodied in the structure  $(\text{SRS})_n$ , where the two sulfurs are attached to each other within the ring'. However, it is unclear what 'the ring' is. There is no ring in the structure recited in the first paragraph of page 8 of applicants' arguments."

In further reply here, the Applicants offer that the "ring" is embodied in the following structure



where R is C<sub>2</sub> to C<sub>20</sub> alkylene (C = C) as well as the other R groups which are cyclic. Accordingly, when m = 0, the Y groups are absent and while the divalent sulfurs would be linked to a single R group, for instance C<sub>2</sub> to C<sub>20</sub> alkylene, the difunctional cross-linking agent is cyclic.

Next, the Examiner has rejected claims 5, 9, 14 and 19 under 35 U.S.C. §112, first paragraph, on the basis that "[T]he specification as filed does not disclose that thiazoles may be used in the instant invention." Additionally, the amendment filed January 29, 2003 is objected to under 35 U.S.C. §132 for introducing new matter into the disclosure. "The added material which is not supported by the original disclosure is as follows: That thiazoles may be used in the instant invention."

In reply to the Applicants previous arguments in support of the recitation of thiazoles in the specification and claims, the Examiner notes that all the Applicants needed to do was disclose the use of thiazoles as an accelerator. The Applicants generally agree, noting that they disclosed other groups including amines, thiols, thiurams, dithiocarbonates, guanidines, thioureas, sulfenamides and xanthates. Failure to name the thiazoles was an inadvertent error. However, as explained by the Applicants, the use of thiazoles was not omitted; their specification disclosed both CBS and MBTS, which are thiazoles. Moreover, thiazoles are not the point of novelty, but merely a component of a vulcanizing package comprising sulfur and at least one accelerator. Relying on the Examiner's own reasoning, all that the Applicants needed to recite in each of their independent claims was "at least one accelerator", which they did. The use of accelerators is not a further limitation to an independent claim that is first introduced by a dependent claim. Amending the specification and dependent claims 5, 9, 14 and 19, merely recites

the known accelerators typically employed with sulfur to vulcanize elastomeric compositions. Accordingly, the Applicants respectfully request that the Examiner withdraw these rejections.

Next, the rejection of claims 1-14 under 35 U.S.C. §102(e) as being anticipated by Yatsuyanagi et al. has been repeated for the reasons set forth in the previous Office Action. In support of this rejection the Examiner refers to the Abstract of Yatsuyanagi et al. which "discloses that sulfur compounds of Formula I may be used or a specific sulfur compound 1 and also discloses that sulfur compound of Formula I is combined with other reagents." The Applicants do not find a definition for "a specific sulfur compound 1" in the patent and believe that the preposition "of" was intended for the preposition "or".

With reference to column 3, lines 42-55, Yatsuyanagi et al. states:

"In accordance with the second aspect of the present invention, there is also provided a vulcanized rubber composition comprising 100 parts by weight of a vulcanizable rubber, a reinforcing filler, and a sulfur compound (1) having the formula (I):



wherein  $R^1$  represents an organic group,  $x$  is an average number of 3 to 5, and  $n$  is an integer of 1 to 100 in an amount of not more than 20 parts by weight of the sulfur compound (1) and sulfur (2) in a ratio by weight (1)/(2) of at least 0.5 and ...."

The Applicants contend that the correct interpretation of line 53 is "of not more than 20 parts by weight of the sulfur compound (1)", not "or the sulfur compound (1)".

Regarding Yatsuyanagi et al., the Applicants contend as before, that it discloses sulfur compounds having more than two sulfur atoms linked together, whereas the Applicants claim difunctional cross-linking agents which their generic formula supports. The Applicants offer the following structures to illustrate their point, where Y is present ( $m = 1$ ).

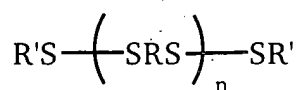
I



The head-to-tail linking of consecutive sulfurs from multiple SRS groups provides groupings of only two sulfurs. The remaining sulfur bond is to an R or a Y group.

Where Y is SR', the structure is

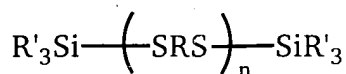
II



The head-to-tail linking of consecutive sulfurs from the SRS group(s) includes a link between the SRS sulfurs and the R'S groups, again resulting in no greater than two sulfurs being linked together.

Where Y is SiR'<sub>3</sub> the structure is

III



and there are two sulfurs where n = 1 and head-to-tail linking of consecutive sulfurs where n is greater than 1.

As should be apparent, the Applicants difunctional cross-linking agents only link two sulfurs together, irrespective of the total number of sulfurs in a given molecule, Example I, for instance, showing eight sulfurs. Accordingly, Yatsuyanagi et al. does not anticipate or suggest the Applicants' invention, because the former requires more than two consecutive sulfurs in their sulfur compound.

The Applicants have addressed the Examiner's allegations regarding end-capping in their previous response and will rely on that position here. Thus, where Y is

SR<sup>1</sup> or SiR<sub>3</sub> in the Applicants' agent, the groups are present in the dimercaptan or other difunctional agent.

While claims 15-20 have again been rejected under 35 U.S.C. §103(a) as obvious over Yasuyanagi et al., the Applicants adhere to their position that pneumatic tires manufactured from a cross-linked elastomeric composition of matter containing the difunctional cross-linking agents of the present invention are not obvious in view of Yatsuyanagi et al., because the reference fails to disclose their difunctional agents.

The Applicants note that the Examiner has addressed the Applicants' traverse of the restriction requirement at length. While the Applicants are content to have the Examiner extend his search to include all of the rubbers recited in the claims, once a generic claim has been allowed, they will respond to one point made in the Final Action. Specifically, where the Examiner stated:

"The term 'unity of invention' pertains to cases filed under the patent cooperation treaty. As the present case was not filed under 35 U.S.C. §371 it is not clear what applicants remarks have to do with the election of species requirement."

The Applicants refer the Examiner to the attached Exhibit B which is page 800-4 from the August 2001 MPEP. Under Section 803.2, the second paragraph contains the phrase "unless the subject matter in a claim lacks unity of invention."

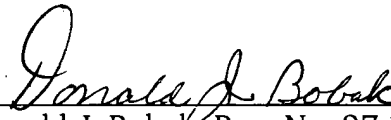
The Applicants acknowledge the Examiner's withdrawal of several rejections based upon consideration of their previous response.

Inasmuch as this Action has been made Final, the Applicants understand that they could now proceed to an Appeal. However, in the interest of compact prosecution, they request that the Examiner consider two U.S. patents that were recently cited in a written opinion from the EPO. These patents are Nos. 3,781,250 and 3,274,142, which were noted in the Applicants third Supplemental Information Disclosure Statement, mailed

December 9, 2003. If the Examiner withdraws this Final and issues a further Office Action, it will be addressed in a timely fashion.

Should the Examiner wish to discuss any of the foregoing in more detail, the undersigned attorney would welcome a telephone call. No additional fees are due with this response.

Respectfully submitted,



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Attorney for Applicants

Dated: January 5, 2004

# LP/ELP POLYMERS

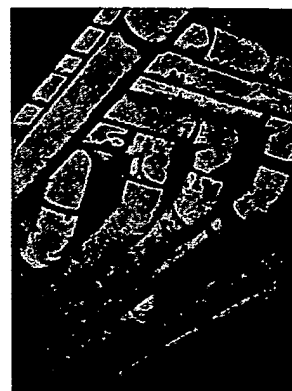
◆  
Liquid Polysulfide Polymers

◆  
Epoxy Terminated  
Liquid Polysulfide Polymers



Exhibit A

## L P / E L P P O L Y M E R S



**S**ealants based on Thiokol® LP liquid polysulfide polymer have been used successfully for more than 50 years. LP polymer's high-performance characteristics — including chemical resistance, corrosion resistance, weatherability and flexibility — make it ideal for use in the construction, aerospace, insulating glass, secondary containment and marine industries.

LP polymers find a unique use as a component of Morton's ELP™ epoxy terminated polysulfide polymers.

The use of LP polymers in any form solves the problem of brittleness that is inherent with most epoxy resins. ELP polymers provide all the positive properties associated with LP polymers while eliminating the mercaptan odor.

This brochure will provide an overview of the LP polymer and ELP epoxy-terminated polymers, including their benefits, applications, chemical structure/properties and curing information.

## THIOKOL LP® LIQUID POLYSULFIDE POLYMER

### *Benefits*

Cured compositions based on the LP polymer exhibit numerous benefits, thanks to the polymer's unique properties. These benefits include:

**Oil, solvent and chemical resistance:** LP polymer-based formulations are resistant to most aliphatic and aromatic hydrocarbons, alcohols, esters, dilute acids and alkalis.

**Aging and weathering resistance:** Products based on LP polymer display excellent resistance to aging, ozone, oxidation, sunlight and weathering. Long-term "Weatherometer" tests — in addition to actual product usage — confirm these materials respond well to daily exposure in varying climates.

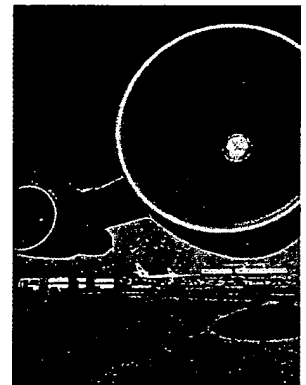
### *Applications*

The unique, high-performance characteristics attributable to LP polymer-based sealants make them popular for use in numerous demanding, diverse application (see Table 1):

**Construction:** The advent of curtain wall and high-rise construction created the need for a sealant that could adhere to various substrates, withstand movements caused by thermal expansion and contractions and by high wind, and still provide a waterproof seal. LP polymer-based sealants are well known for their adhesion, flexibility and water resistance. These characteristics are ideal for bridges, airfields, road construction, water tanks and sewage water treatment plants, as well.

**TABLE 1 • LIQUID POLYSULFIDE POLYMER APPLICATIONS**

Applicati n	LP-3	LP-33	LP-977	LP-980	LP-2	LP-32	LP-12	LP-31
Aircraft sealants								
Automotive sealants								
Building sealants			•	•	•	•	•	•
Flow type sealants			•	•	•	•	•	
Heavy construction sealants			•	•	•	•		•
Insulating glass sealants			•	•	•	•	•	
Marine sealants			•	•	•	•		•
Dental molding compounds					•			
Epoxy modifiers	•	•						
Fluid membranes			•	•	•	•		
Concrete coatings	•	•						
Intumescent coatings	•	•						
Electrical potting	•	•	•	•	•	•		
Leather impregnation	•		•		•			
Propellant binders	•	•						



2

**A**erospace: Morton's experience in sealing aircraft dates back to 1935 when the China Clipper made the first transoceanic flight — with polysulfide lining its fuel tanks. Since World War II, LP polymer-based sealants have been used on virtually every military and commercial aircraft built. LP polymer's extraordinary chemical-, oil- and fuel-resistance makes it suitable for sealing integral fuel tanks and other critical aircraft areas.

**Insulating glass:** In addition to its extremely low moisture permeability, LP polymer provides flexibility to sealants over a wide temperature range when used as a base component. Flexibility is an important attribute in insulating glass applications where substantial glass movement is anticipated. LP polymer-based sealants also provide excellent weatherability, including UV-resistance, and low gas diffusion values to insulating glass windows, patio doors and windows for environmental chambers.

**Secondary containment:** Ever-stringent environmental regulations for above-ground storage tanks led to the diversification of LP polymer

and the development of Thiokol® formulated products. This line of coatings, sealants and fabric-reinforced liners make concrete, asphalt and earthen secondary containment dikes more effective in protecting groundwater in the event of a spill or leak. The chemical-resistant nature of the LP polymer — along with its flexibility — helps create an elastomeric skin that is virtually impermeable to most chemical and fuel spills.

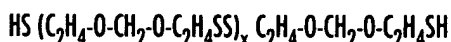
**Marine:** Resistance to the corrosive effects of sea water, excellent adhesion to a variety of substrates and flexibility have made LP polymer-based sealants, adhesives and glazing compounds popular in the marine industry. Applications include sealing lapstrake seams and joints, centerboard wells, stern and keel joints, portholes, deck hardware fittings and deck seams.

**Other uses:** The LP polymer has found use in a varied mix of applications, including: cold molding, potting, gas main sealing, plastic tooling, wire and cable sealing, leather impregnation, dental molding, printing blanket/roller compounds and much more.

### Chemical structure/properties

Polysulfides are polymers of bis-(ethylene oxy) methane containing disulfide linkages.

The reactive terminal groups used for curing are mercaptan (-SH). The general structure of the LP polymer is:



A comparison of chemical properties of various LP polymers is shown in Table 2. Other properties include:

**Adhesion properties:** Excellent adhesion to most substrates, coupled with good flexibility is obtained with properly compounded polysulfide compositions. These compounds can achieve typical peel adhesion values of 20 lbs. to 60 lbs./in. (3.6 kg. to 10.76 kg./cm.) to aluminum, concrete, steel and glass surfaces.

Adhesion in shear values to aluminum range from 100 lbs. to 200 lbs./sq. in. (7.0 kg. to 14.1 kg./sq. cm.) for cross-sections 1/8 in. (0.3 cm.) thick.

**Electrical properties:** Cured LP polymers exhibit good electrical properties, which can be improved through compounding. Typical electrical and special properties at 77°F (25°C) and 50% relative humidity of cured compositions are shown in Table 3.

**Stress-strain properties:** LP polymers are cured to an elastomeric rubber with moderate stress-strain properties. These properties can vary widely and are dependent on the curing system, formulation variables and processing techniques. See properties in Table 4.

**Toxicological properties:** Under the criteria set forth under OSHA's Hazard Communication Standard (29 CFR 1910.1200), Morton classifies LP polymer products as non-hazardous. When used in accordance with prescribed procedures, they do not pose a health hazard. Toxicity tests conducted on a representative LP polymer used in sealant applications indicate that the polymer is not an eye irritant and has a low order of oral toxicity (LD50 > 5 g/kg). Tests on lower molecular weight LP products show similar findings. When using sealants or other formulated products, the health and safety considerations relating to the other ingredients should be examined.

~ 82-3

TABLE 2 • PROPERTIES OF LP LIQUID POLYSULFIDE POLYMERS

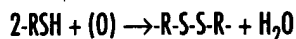
Typical Properties	LP-3 <sup>c</sup>	LP-33 <sup>c</sup>	LP-977	LP-980	LP-2	LP-32	LP-12 <sup>c</sup>	LP-31
Color-MPQC-29-A	50 max.	30 max.	70 max.	50 max.	70 max.	50 max.	40 max.	100 max
Viscosity-poise 77°F (25°)	9.4-14.4	15-20	100-150	100-150	410-525	410-525	410-525	800-1450
Moisture content, %	0.1 max.	0.1 max.	0.3 max.	0.3 max.	0.3 max.	0.3 max.	0.3 max.	0.3
Mercaptan content, %	5.9-7.7	5.0-6.5	2.50-3.50	2.50-3.50	1.70-2.20	1.50-2.00	1.50-2.00	1.0-1.5
<b>General Properties</b>								
Average molecular weight	1000	1000	2500	2500	4000	4000	4000	8000
Refractive index n/D	1.5649		1.568	1.566		1.5689		1.5728
Pour point, °F (°C)	-15 (-26)	-10 (-23)	40 (4)	40 (4)	45 (7)	45 (7)	45 (7)	50 (10)
Flash point (PMCC), °F (°C)	<350 (177)	<350 (177)	<350 (177)	<350 (177)	<350 (177)	<350 (177)	<350 (177)	<350 (177)
% Cross-linking agent	2.0	0.5	2.0	0.5	2.0	0.5	0.2	0.5
Sp Gr @ 77°F (25°C)	1.31	1.27	1.29	1.29	1.29	1.29	1.29	1.31
Avg. viscosity poises 40°F (4°C)	90	165	770	770	3,800	3,800	3,800	7,400
Avg. viscosity poises 150°F (65°C)	1.5	2.1	11	11	65	65	65	140
*Low temp. flex., G <sub>10,000</sub> °F (°C)	-65 (-54)	-65 (-54)	-65 (-54)	-65 (-54)	-65 (-54)	-65 (-54)	-65 (-54)	-65 (-54)
(708 kb/cm <sup>2</sup> )								

<sup>c</sup>Cured compound

Clarified

**C**uring information

Curing of LP polymers to high molecular weight elastomers is normally accomplished by oxidizing the polymers' thiol (-SH) terminals to disulfide (-S-S-) bonds:

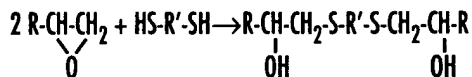


**Common curing agents:** The curing agents most commonly used are oxygen-donating materials such as manganese dioxide, calcium peroxide, zinc peroxide, cumene hydroperoxide, sodium perborate and lead dioxide.\* Lower valence metallic oxides, other organic hydroperoxides, metallic paint dryers and aldehydes can also function as curatives.

*\*Note: Lead dioxide provides excellent cures and, in some applications, is the curative of choice. However, given Morton's proactive stance as a member of CMA's Responsible Care initiative, we urge you to contact Morton's R&D lab for assistance in choosing another, more environmentally benign curative.*

**Selection of curing agents:** The final selection of a curing agent is based on its overall performance with respect to a number of requirements, including cost, stability, controllable cure rate, heat stability of cured composition, elastomeric properties, toxicity, etc. The chart on page 3 illustrates some of differences obtained with various curing agents.

**Curing with epoxy resins:** LP polymers can also co-cure with various polymers to yield very flexible and/or plastic properties based on the ratio of ingredients used. Epoxy resins can be cured with polysulfide polymers according to the following reaction:



Polysulfide/amine systems are commonly used as curatives for epoxy resins to provide tough, flexible products. In particular, LP-3 polymer — the lowest molecular weight LP polymer — is used in coatings formulations to lower the viscosity of the formulation and to facilitate mixing and application of the resin.

## TYPICAL CURING AGENTS

For use with LP-2, LP-12, LP-31\* & LP-32

### MnO<sub>2</sub> (Active grade)

Provides improved heat resistance and lower toxicity. Amount required: 7.5 to 10.0 parts/100 parts 4,000 m.w. LP polymer.\*\*

### CaO<sub>2</sub>

Requires moisture for activation. Can be used to provide a light-colored, one-part moisture curing system. Amount required: 10.0 to 12.0 parts/100 parts LP polymer.

### ZnO<sub>2</sub>

Reacts slowly with LP polymers. Can be used to provide white compositions with moderate heat stability. Amount required: 10.0 parts/100 parts LP polymer.

### Cumene hydroperoxide

A convenient liquid form useful for obtaining pourable compositions that have compression-set resistance. Amount required: 8.0 parts/100 parts LP polymer.

### PbO<sub>2</sub> (Fast, medium or slow grade)

Provides an easily controllable LP polymer curing rate. Amount required: 7.5 to 10.0 parts/100 parts LP polymer.

### NaBO<sub>3</sub> • H<sub>2</sub>O (Sodium perborate monohydrate)

Provides light-colored, non-staining one- and two-part sealants able to be manufactured in a range of colors for building sealants. Are low modulus, highly elastic, water-, UV- and mold-resistant. Amount required: 4.0 parts/100 parts LP polymer.

*\*Note: Due to its higher molecular weight, LP-31 requires generally less curative than the above-recommended amount.*

*\*\* Note: Lower molecular weight polysulfide polymer requires more MnO<sub>2</sub>, but may cause greater risk of exotherm.*

## TABLE 3 ELECTRICAL AND SPECIAL PROPERTIES OF CURED THIOKOL LP'S

### Electrical Properties

Volume resistivity (ohm-cm)	2x10 <sup>11</sup> -7x10 <sup>12</sup>
Surface resistivity (ohms)	1x10 <sup>12</sup> -2x10 <sup>14</sup>
Dielectric constant@1Kc	5.5-8
Dissipation factor@1Kc	0.001-0.010

### Special Properties

Thermal Conductivity	3.3x10 <sup>-4</sup> cal/sec cm <sup>2</sup> /°C/cm
Heat of Combustion	5284 cal/gm (by adiabatic calorimeter)
Diffusivity (sealant)	2.9x10 <sup>-3</sup> ft <sup>2</sup> /hr
Specific heat (sealant)	0.42 cal/gm
Coefficient of expansion	4.8 to 5.3 x 10 <sup>-5</sup> in/in/°F (lead cured)

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(MPEP § 806.04 - § 806.04(i)) or distinct (MPEP § 806.05 - § 806.05(i)).

If the search and examination of an entire application can be made without serious burden, the examiner must examine it on the merits, even though it includes claims to independent or distinct inventions.

### CRITERIA FOR RESTRICTION BETWEEN PATENTABLY DISTINCT INVENTIONS

There are two criteria for a proper requirement for restriction between patentably distinct inventions:

(A) The inventions must be independent (see MPEP § 802.01, § 806.04, § 808.01) or distinct as claimed (see MPEP § 806.05 - § 806.05(i)); and

(B) There must be a serious burden on the examiner if restriction is required (see MPEP § 803.02, § 806.04(a) - § 806.04(i), § 808.01(a), and § 808.02).

### GUIDELINES

Examiners must provide reasons and/or examples to support conclusions, but need not cite documents to support the restriction requirement in most cases.

Where plural inventions are capable of being viewed as related in two ways, both applicable criteria for distinctness must be demonstrated to support a restriction requirement.

If there is an express admission that the claimed inventions are obvious over each other within the meaning of 35 U.S.C. 103, restriction should not be required. *In re Lee*, 199 USPQ 108 (Comm'r Pat. 1978).

For purposes of the initial requirement, a serious burden on the examiner may be *prima facie* shown if the examiner shows by appropriate explanation of separate classification, or separate status in the art, or a different field of search as defined in MPEP § 808.02. That *prima facie* showing may be rebutted by appropriate showings or evidence by the applicant. Insofar as the criteria for restriction practice relating to Markush-type claims is concerned, the criteria is set forth in MPEP § 803.02. Insofar as the criteria for restriction or election practice relating to claims to genus-species, see MPEP § 806.04(a) - § 806.04(i) and § 808.01(a).

### 803.01 Review by Examiner with at Least Partial Signatory Authority

Since requirements for restriction under 35 U.S.C. 121 are discretionary with the Commissioner, it becomes very important that the practice under this section be carefully administered. Notwithstanding the fact that this section of the statute apparently protects the applicant against the dangers that previously might have resulted from compliance with an improper requirement for restriction, IT STILL REMAINS IMPORTANT FROM THE STANDPOINT OF THE PUBLIC INTEREST THAT NO REQUIREMENTS BE MADE WHICH MIGHT RESULT IN THE ISSUANCE OF TWO PATENTS FOR THE SAME INVENTION. Therefore, to guard against this possibility, only an examiner with permanent or temporary full signatory authority may sign final and non-final Office actions containing a final requirement for restriction, except that an examiner with permanent or temporary partial signatory authority may sign non-final Office actions containing a final requirement for restriction.

### 803.02 Restriction — Markush Claims

#### PRACTICE RE MARKUSH-TYPE CLAIMS

If the members of the Markush group are sufficiently few in number or so closely related that a search and examination of the entire claim can be made without serious burden, the examiner must examine all the members of the Markush group in the claim on the merits, even though they are directed to independent and distinct inventions. In such a case, the examiner will not follow the procedure described below and will not require restriction.

Since the decisions in *In re Weber*, 580 F.2d 455, 198 USPQ 328 (CCPA 1978) and *In re Haas*, 580 F.2d 461, 198 USPQ 334 (CCPA 1978), it is improper for the Office to refuse to examine that which applicants regard as their invention, unless the subject matter in a claim lacks unity of invention. *In re Harnish*, 631 F.2d 716, 206 USPQ 300 (CCPA 1980); and *Ex parte Hozumi*, 3 USPQ2d 1059 (Bd. Pat. App. & Int. 1984). Broadly, unity of invention exists where compounds included within a Markush group (1) share a